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The U.S. Copper Mining Industry

A Perspective on Financial Health

By T. T. Tomimatsu

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A Perspective on Financial Health

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UNITED STATES DEPARTMENT OF THE INTERIOR
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BUREAU OF MINES
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THE U.S. COPPER MINING INDUSTRY

A PERSPECTIVE ON FINANCIAL HEALTH

by

T.T. Tomimatsu[1]

ABSTRACT

This Bureau of Mines paper investigates, explores, and analyzes the corporate structure dynamics and financial ratios to evaluate the economic health of the U.S. copper producers. It highlights the corporate policy options and measures of corporate profitability and suggests that a competitive domestic copper industry will exist in the future.

The study highlights the activities of 14 selected major copper-producing companies, including their subsidiaries or affiliates, that were responsible for more than 95 percent of the total U.S. production in each of the years since 1969. The selected firms are not all primarily in the business of producing copper. Several of the large producers are classified by the financial institutions as integrated oil and gas enterprises.

INTRODUCTION

One of the responsibilities of the Bureau of Mines is to investigate the economic conditions affecting the mineral industries. This is in concert with the Mining and Minerals Policy Act of 1970, one of the requirements of which is assessment of the state of the domestic mining industry (*29*)[2]. This paper pursues this mission through financial economic investigation and analysis to interpret the economic well-being of the U.S. copper industry. Large quantities of corporate information and data have been collected and analyzed to provide new insights into corporate dynamics, and to assess the copper industry's capability of generating the huge amount of capital required for exploration, development of new mines, improvement of existing mines, and effecting technological improvements in productivity.

Fourteen U.S. copper companies were selected on the basis of their U.S. copper output. Each year, since 1969, the selected companies' production represented more than 95 percent of the total national copper production. These companies' share of the total U.S. copper production rose to 98 percent in 1978. The financial actions, policies, decisions, and trends of these copper companies provide the key indicators to the state of the U.S. copper industry.

This Bureau of Mines report presents a 10-year copper industry analysis, covering a period in which, in addition to the prevalent unstable copper prices, the industry was subject to periodic strikes, price controls (1973–74), and huge capital expenditures for environmental and pollution control facilities (societal expenditures).

Within the past 10-year period (1969–78), the copper end-use pattern has not changed mate-

[1] Certified Public Accountant, financial economist, Branch of Technical Analysis, Bureau of Mines, Washington, D.C.

[2] Italic numbers in parentheses refer to items in the list of references at the end of this report.

rially, except the very small offsetting percentage increases and decreases among the five categories. It is important to note, however, that net imports of copper have more than doubled during the past 10 years.

Copper prices are extremely sensitive to changes in supply and demand, and they are set under several different pricing mechanisms. A capacity-demand imbalance together with the slowdown in the U.S. economy depressed copper prices for an unusually long period of time (1974–78), during which some producers shipped copper on a consignment basis. The largest domestic copper mining company relinquished its rights to set prices and adopted the pricing basis of the New York Commodity Exchange (COMEX), the organized marketplace for contracts for future delivery of copper. Subsequently, other major copper producers followed this pricing mechanism. In the last half of 1978, excess inventories of copper were reduced. Since then, prices have moved upward. Accordingly, the economic health has improved for several copper mining firms. For example, an increase of only 1 cent per pound in copper prices generates improvements in cash flow and profits. Currently, the basic copper price is exempt from the price guidelines of the Council on Wage and Price Stability (COWPS).

QUALITY AND RELIABILITY OF BUSINESS DATA AND INFORMATION

The U.S. Government requires all publicly held companies to register with the Securities and Exchange Commission and to file reports on their business operations. The following required documents and other optional materials were used in this investigation:

- Annual and Quarterly Reports to Shareholders.
- Annual Report Form 10–K, the authoritative report of the company; 10–Q quarterly reports; monthly reports of significant events; Proxy Statements; Securities Registration, S–1; and Prospectuses to the Securities and Exchange Commission. These reports are company information filed with and made public by the Securities and Exchange Commission. This research study considers these reports as final information.
- Special reports for security analyst meetings, companies' news releases, and general reports released to equity holders.
- Testimony before selected Congressional special committees by the selected companies and their subsidiaries.

These sources have been supplemented by personal conversations with executive officers of the involved companies and by information developed from other sources as well as by literature reviews of many technical periodicals and reports.

The current required disclosures have improved the quality and quantity of financial and economic data and were helpful in this research effort. However, because of nonstandardization in reporting, the investigation required critical in-depth analysis in the selection of relevant information. These data were specifically gathered, analyzed, interpreted, developed, and published for this purpose and are not fragmented with gaps, omissions, or duplications. Every attempt has been made to utilize data supplied by the companies pursuant to law.

No attempt was made to show the impact on profitability of such variables as application of alternative methods of accounting; that is, in inventory accounting—LIFO (last-in, first-out) versus FIFO (first-in, first-out), capitalizing finance costs during construction, expensing currently to operations, deferrable costs, etc. However, sufficient relevant data on a vast array of economic information were collected, analyzed, documented, and evaluated to develop an economic-financial conclusion.

OVERVIEW OF THE U.S. COPPER MINING INDUSTRY

Copper has been used for more than 6,000 years and is one of the world's oldest known metals. Early uses of copper were in tools, weapons, and ornaments. Bronze—an alloy of copper and tin—and brass—an alloy of copper and zinc—have also been used extensively. In the nineteenth and twentieth centuries, copper has been used heavily in electrical equipment and power distribution systems. Although substitute materials have been developed, the production and use of copper have increased steadily, and this trend is projected to continue beyond the year 2000 (*22*).

CONSUMPTION

U.S. copper consumption has grown by about 9.1 percent to 2.478 million tons in 1978 from 2.271 million tons in 1969 (*22*). This low growth probably reflects the maturity of the U.S. copper market compared with that of other countries and the fact that the United States now imports a much greater amount of manufactured goods that probably contain finished copper. Excluding scrap, U.S. consumption of primary copper accounted for less than one-fourth of total world use in 1978, down from about 27 percent in 1969.

The major end-use of copper in the United States is for electrical equipment and supplies, which accounted for about 58 percent of total U.S. consumption in 1978. Copper is used in electric motors, power generators, power distribution systems, and other wiring. Copper is also used in construction materials (about 19 percent of 1978 use) for roofing, plumbing, and bronze and brass hardware for buildings and homes. Use of copper is important in nonelectrical machinery (9 percent of 1978 consumption), such as commercial air conditioning, and in transportation equipment (9 percent of 1978 consumption), such as automotive and marine parts. Consumption in ordnance and miscellaneous products accounted for the remainder of U.S copper use in 1978.

The most notable substitute for copper is aluminum, particularly in power transmission cables. In the future, fiber optics may replace copper in some telephone transmission lines (*22*).

PRODUCTION

U.S. copper production has stagnated over the 1969–78 period; high costs of meeting U.S. environmental standards and the availability of lower priced imported copper has led to a significant amount of excess capacity in the United States. In 1978, U.S. copper mine production was about 1.5 million tons out of total mine capacity of 2 million tons. As a result, U.S. production was above 1.7 million tons in only 2 of these 10 years. On the other hand, estimated annual world production increased significantly during the 1969–78 period, rising from about 6.2 million tons to 8.2 million tons.

Table 1 shows that of the 14 major U.S. copper producers (*1–4, 6, 10–12, 15, 18–21, 41*), only five have increased copper output over the 1969–78 period and that their increased production resulted in lower production by the rest of U.S. copper mining firms. Coupled with increased competition from foreign producers, this trend may indicate that the five companies with increased output over the decade—Newmont, Pennzoil, Asarco, Amax, and Cities Service—were able to produce copper at a lower cost than other U.S firms. Kennecott appeared to lose the most during the decade, with its U.S. production dropping by about 178,000 tons, or almost 36 percent.

The largest copper companies in the United States are vertically integrated; that is, they operate in all major phases of the industry—mining (removal of ore from the earth), concentration, smelting (processing of ore for the metal), and refining (purification of the metal). Some even have operations that fabricate part of their output into tubing, wire, and other end-use products. This vertical integration resulted from the significant economies of scale gained from the operation of very large mining and processing operations.

Despite this tendency towards vertical integration, the domestic copper market has become more competitive. Table 2 shows that the concentration of U.S. copper production in the largest firms has declined over the last 40 years from about 75 percent to about 63 percent because of new entrants into copper mining (*14*). Fur-

Table 1.—Fourteen leading U.S. copper producers' U.S. production contrasted to total U.S. and rest-of-world copper production, 1969–78

(Thousand short tons)

Companies	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Kennecott Copper Corp.[1]	496.0	518.9	456.1	460.6	471.7	402.2	288.1	346.4	358.2	318.2
Phelps Dodge Corp.	284.2	313.5	281.2	305.4	319.6	281.3	249.7	331.0	276.7	319.0
Atlantic Richfield Co.[2]	155.9	242.1	182.0	233.5	200.5	190.1	149.6	164.1	170.6	142.8
Newmont Mining Corp.	116.0	114.6	103.6	151.8	160.0	151.6	133.9	150.7	154.5	156.9
Pennzoil Co.	65.0	77.0	94.0	137.0	127.0	128.0	134.0	140.0	123.0	118.0
ASARCO Inc.[3]	78.5	76.3	67.7	74.4	76.2	83.2	80.4	94.4	73.6	100.9
Inspiration Consolidated Copper Co.[4]	66.0	69.9	58.8	65.8	65.2	61.2	55.8	47.0	27.6	39.7
Amax Inc.[5]	([6])	([6])	([6])	([6])	32.1	22.7	7.6	47.8	59.7	52.1
Cities Service Co.	36.8	43.5	39.4	33.4	33.3	33.9	76.7	84.5	72.3	90.8
Cyprus Mines Corp.[7]	86.2	86.3	91.1	113.9	119.6	108.5	99.3	98.7	83.0	70.7
Louisiana Land and Exploration Co.[8]	78.4	67.8	58.4	70.4	78.2	66.6	70.8	46.1	43.0	40.7
Hecla Mining Co.[9]	1.9	1.9	2.2	1.9	.4	.5	.5	14.5	18.4	.6
Ranchers Exploration and Development Corp.	4.4	8.7	11.6	7.4	9.4	11.1	7.8	9.0	9.3	8.2
UV Industries Inc.[10]	14.2	13.8	17.0	14.9	20.4	24.2	17.6	23.1	21.5	5.4
Total 14 companies' production	1,483.5	1,634.3	1,463.1	1,670.4	1,713.6	1,565.1	1,371.8	1,597.3	1,491.4	1,464.0
Total U.S. production	1,544.6	1,719.7	1,522.2	1,664.8	1,717.9	1,597.0	1,413.4	1,605.6	1,504.0	P1,490.3
Percent of total U.S. production by 14 companies	96.0	95.0	96.1	100.3	99.8	98.0	97.1	99.5	99.2	98.2
Total world copper production	6,547.3	6,993.7	7,100.8	7,758.8	8,269.3	8,453.6	8,099.9	8,670.9	8,796.8	P8,524.5
Percent of total world production by 14 companies	22.7	23.4	20.6	21.5	20.7	18.5	16.9	18.4	17.0	17.2

P Preliminary.

[1] Includes Carborundum Co. acquired Dec. 31, 1977.

[2] Anaconda Co. acquired Jan. 12, 1977. All data prior to Jan. 12, 1977, cover Anaconda Co. only.

[3] Bendix Corp. interest about 20 percent with limitation of 21 percent to Jan. 1, 1985.

[4] Owned by 2 Canadian companies (Hudson Bay Mining and Smelting Co., Ltd., and Minerals and Resources Corp. Ltd.), Mar. 30, 1979; Anglo American Corp. of South Africa Ltd. controls more than 40 percent of the outstanding common stock of both companies. Anaconda Co., unit of Atlantic Richfield, owns 93 percent of class A preferred stock.

[5] Standard Oil Co. of California interest 20.6 percent; and Selection Trust Ltd. (United Kingdom) interest 8.3 percent.

[6] Anamax Mining Co. was formed June 1973 through equal partnership with Anaconda Co., a unit of Atlantic Richfield Co.

[7] Sept. 21, 1979, became a wholly owned subsidiary of Standard Oil Co. of Indiana.

[8] Copper Range Co. acquired May 24, 1977. All data prior to this date cover Copper Range Co. only.

[9] Lakeshore mine leases jointly terminated with El Paso Natural Gas Co. and property returned to Papago Tribe, October 1978. Noranda Exploration Inc., a U.S. subsidiary of Noranda Mines Ltd., (Canada), has entered into an agreement with the Papago Tribe to develop and operate the Lakeshore copper mine.

[10] Company in process of liquidation, Mar. 26, 1979.

Sources: Bureau of Mines, based on analysis of annual reports and form 10-K data submitted to Securities and Exchange Commission; Non-Ferrous Metal Data, American Bureau of Metal Statistics, Inc.,; and annual data 1979, Copper Supply and Consumption, Copper Development Association Inc.

thermore, the large expansion of production in less developed countries (LDC's) and the expropriation and nationalization of copper production facilities by some of these LDC's has led to greater price competition in the both worldwide and U.S. copper markets.

As stated previously, U.S. copper production has remained fairly level over the past decade. There are several major reasons for this stagnation. One factor is that U.S. copper ore grades generally declined over the 1969–78 period. Also, production costs are generally lower for the major foreign copper producers (*12*). Furthermore, inflation in the United States has not only raised production costs but has also sharply increased the capital costs of opening new mines. To meet U.S. environmental standards, copper producers have had to divert funds that would have gone for exploration or capacity expansion into outlays for pollution-control equipment (*2, 33, 36–39*). Last, but certainly not the least important, significant increases in energy costs resulting from OPEC actions and declining ore quality have added to production costs; copper mining and refining are very energy-intensive processes.

OTHER IMPORTANT FACTORS

In addition to the above reasons for stagnant copper production over the 1969–78 period, the U.S. copper mining industry has faced a set of additional factors that have affected its financial health. First of all, some foreign producers—now owned by their governments—respond to lower copper prices by maximizing copper production to earn needed foreign exchange and to maintain employment in their countries. This forces copper prices even lower than they normally might have fallen. Another important factor affecting the U.S. copper industry is the volatility of copper prices. This volatility is caused by several factors:

- The sensitivity of copper use to the state of the economy.

- The fact that production costs are lowest when operations are running at close to full capacity. This puts downward pressure on prices during recessions.
- Inventory control problems, which stem from the difficulty in forecasting copper sales and from the desire to keep operations running at close to full capacity.
- The fact that new mines and refineries are very large can lead to sharp price declines when the new supplies reach the market.

Also, price controls in the early 1970's probably kept copper producer earnings from being greater. In addition, the relative stagnation of the U.S. stock market during 1969–78 has probably made it difficult to raise needed funds for sellng new stock, and, as a result, some firms have had to raise funds through long-term borrowing at high interest rates.

There are several positive factors that help U.S. copper firms. Although some other metal producers are subject to the Federal price guidelines of the Council on Wage and Price Stability, copper producers are now exempt because copper prices closely follow prices set on the New York Commodity Exchange (COMEX) and the London Metal Exchange (LME). Another positive factor is the revenue from the sale of byproducts. Byproducts of copper operations include gold, silver, molybdenum, and sometimes platinum-group metals. Although the prices of these metals generally follow the trend of copper prices over the course of the business cycle, byproduct revenues can cut losses or improve profits significantly. For instance, in 1978, sales of byproducts of copper mining added about $100 million to Kennecott Corp.'s total revenues (*12*).

Table 2.—Percent of U.S. copper production by top producing companies in 1936 and 1978

Company	Percent of total U.S. production of copper	
	1936	1978
Kennecott Copper Corp.	30.5	21.3
Phelps Dodge Corp.	20.6	21.4
Anaconda Copper Co. (now a unit of Atlantic Richfield Co.)	17.4	9.6
Columet and Hecla Corp. (now a unit of Signal Co.)	5.9	(1)
Newmont Mining Co.	(1)	10.5
Total	74.4	e62.8

e Estimated.
1 Not among the first 4 major producers.

Sources: Bureau of Mines, based on analysis of annual reports and form 10-K data submitted to Securities and Exchange Commission; Non-Ferrous Metal Data, American Bureau of Metal Statistics, Inc.

OUTLOOK

The Bureau of Mines forecasts a significant increase in world and U.S. consumption and production of copper by the year 2000 (*22–23*). Domestic primary copper production is forecast to be 3.15 million short tons by the year 2000; this maintains approximately the same ratio of U.S. production to the total world production (forecast to be 19.5 million short tons in 2000) as in 1978. (See figure 1 and table 3.) In order to reach projected production, U.S. producers (and particularly the 14 largest companies) must more than double their 1978 production capacities. However, analysis of the producers' commitments for capital outlay and future plans (as reported in the annual 10–K reports to the Securities and Exchange Commission (SEC)) and information from responsible officials in the private sector do not yet indicate any thrust for doubling the 1978 production by the year 2000. Because of the long time period necessary for exploration and the opening of new mines and processing plants, U.S. firms would soon need to be starting plans to expand capacity.

The alternative to the opening of new mines and refining plants is the expansion of present capacity by applying technological innovations. Major technological innovations in mining have occurred during the past 30 years. Examples are increasing truck capacity from 25 tons to 150–200 tons and using mining equipment that nearly tripled worker productivity. However, this will be difficult to match during the next 20 years. During 1977, some 33,200 copper miners were employed in producing nearly 1,500,000 short tons of copper. By 2000, producers may face a labor shortage, since barring major advances in technology, 30,000 additional miners would be needed to meet projected production (*16–17*). Based on analysis of quarterly and annual reports of copper-producing companies, the current major thrust of capital outlays to meet mandatory societal expenses leaves a small balance of funds available for technological innovation to increase productivity. As a result, a review may be necessary to assess the differences between private commitment of funds and Government forecasts so that consideration may be

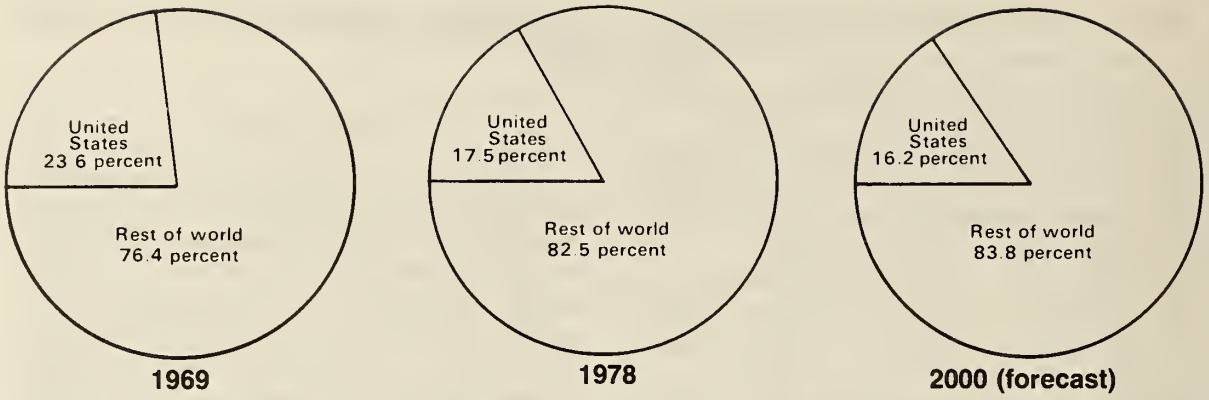

Figure 1. Comparison of U.S. copper mining production with rest-of-world production in 1969, 1978, and 2000 (forecast).

Sources: Non-Ferrous Metal Data, American Bureau of Metal Statistics, Inc.; annual data 1979, Copper Study and Consumption; Copper Development Association Inc.

given to policies that would sustain the U.S. copper industry's competitive position.

NATIONAL SECURITY ASPECTS

Copper has and will continue to be indispensable to U.S. national security (*40*). In 1941, copper was included as a strategic material in order to control inventories of materials under the provisions of the Strategic Materials Act of 1939 (*32*). It was classified as a "critical material" and became subject to allocation and conservation during World War II. Later copper was included again after the enactment of the Strategic and Critical Materials Stock Piling Act of 1946. (*30*). The initial copper stockpile objective was in excess of 1 million short tons. By August 1973 this objective had been reduced to zero. On May 2, 1980, the Federal Emergency Management Agency set the current stockpile goal at 1 million tons of refined copper (*31*).

Copper has been subject to Federal Government assistance to stimulate production. During the Korean conflict, the Defense Production Act of 1950 provided the mechanism for favorable loans, purchase contracts, floor prices, and accelerated depreciation guidelines for Federal taxation purposes (*24*).

Table 3.—Primary copper production, 1978 and 2000 (forecast)

	1978		2000	
	Thousand short tons	Percent	Thousand short tons	Percent
14 companies	[1]1,464.0	17.2	3,093	15.9
Other U.S. companies	[1] 26.3	.3	[2]57	.3
Total United States	1,490.3	17.5	3,150	16.2
Rest of the world	7,034.2	82.5	16,350	83.8
World total	8,524.5	100.0	19,500	100.0

[1] Preliminary.
[2] Bureau of Mines Mineral Commodity Profiles, 1979.

Source: Bureau of Mines, based on analysis of annual data 1979, from Copper Development Association Inc.

FINANCIAL ECONOMIC ANALYSIS AND ASSESSMENT—14 LARGEST U.S. COPPER PRODUCERS

There are many kinds of quantitative measures of the financial health of a company and its success in operations. Company profitability is the choice for this study because of its impact on the generation of capital, both internally (retained earnings plus nonfund items) and externally (public offerings of stock and bonds and special money market borrowing). One set of widely accepted measures of profitability is the rate of return on average shareholders' equity and on average total invested capital. Tables 4 and 5 show these rates of return over the 1969–78 period for the 14 major copper producers, and figure 2 compares the average return on equity of these firms to the return on equity of all U.S. manufacturing firms.

DEFINITIONS AND QUANTITATIVE PERFORMANCE MEASUREMENTS

There are many factors that contribute to the profitability of the copper industry, many of which are subject to quantitative and qualitative analysis. For example, companies have various accounting options, including the capitalization of financial costs during mine development, the treatment of revenues from coproducts or byproducts of copper, and the method of reporting returns from overseas joint ventures (*5*). Treatment of foreign exchange gains and losses is also a complicating factor (*8*). Although the impact of these and many other variations in accounting methods are reflected in the profitability of the various copper companies, long-term trends in the profitability of U.S. copper companies have not been distorted. As a result, no attempt has been made to adjust reported earnings for differences in accounting procedures.

Two classic measures of return on investment have been employed in this analysis—the rates of return on both average shareholders' equity and average total invested capital. Averages on shareholders' equity and total invested capital were utilized to avoid the extreme rate variance that is due to very large profits or losses in any one year. The definitions of the terms used in this investigation are as follows:

Net income or earnings (P)—Company profits after taxes, after extraordinary charges or credits, and available to shareholders.

Interest cost (I_1)—Interest and financing charges on long-term indebtedness (bonds, debentures, etc.).

Shareholders' equity (E)—Common stock plus surplus (retained earnings), surplus reserves, unamortized debt premium, capital stock premium, less treasury stock plus convertible preferred stock; E_1—beginning of year; E_2—end of year.

Total invested capital (V)—Long-term debt plus preferred stock and shareholders' equity (E); V_1—beginning of year, V_2—end of year.

Table 4.—Fourteen leading U.S. copper producers, return on shareholders' equity, 1969–78[1]

(Percent)

Companies	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Kennecott Copper Corp.	15.62	13.28	7.26	3.99	12.72	15.32	1.52	0.62	0.52	0.36
Phelps Dodge Corp.	15.73	17.96	11.04	11.26	13.93	14.25	5.19	4.60	2.02	3.41
Atlantic Richfield Co.	8.88	5.72	(34.70)	14.60	8.64	21.40	(3.21)	1.37	15.51	15.37
Newmont Mining Corp.	18.18	19.05	11.75	9.29	19.60	18.90	8.22	7.50	.79	5.41
Pennzoil Co.	16.25	15.78	7.12	12.09	14.82	19.20	19.70	27.43	16.93	20.07
ASARCO Inc.	16.41	15.60	5.45	6.89	15.46	15.36	2.99	5.00	(3.54)	5.67
Inspiration Consolidated Copper Co.	25.21	28.98	12.73	16.41	17.60	10.57	(3.79)	.11	(10.38)	(7.97)
Amax Inc.	15.27	11.69	7.85	9.77	14.21	15.95	11.59	10.24	4.20	8.88
Cities Service Co.	10.71	9.10	7.75	8.00	9.91	12.72	8.17	12.03	10.74	6.03
Cyprus Mines Corp.	18.16	16.88	13.74	13.01	15.41	16.84	3.50	3.65	(3.56)	16.33
Louisiana Land and Exploration Co.	17.22	9.23	(5.33)	(7.06)	(10.56)	15.94	(12.17)	(2.31)	22.14	19.21
Hecla Mining Co.	12.37	11.25	7.93	5.13	8.14	14.46	9.09	(8.29)	(24.21)	(8,931.73)
Ranchers Exploration and Development Corp.	11.48	16.00	9.10	8.41	5.80	17.28	13.87	5.28	7.55	17.39
UV Industries Inc.	23.96	5.73	4.20	9.31	15.50	19.23	13.91	17.43	16.91	16.37
All 14 companies[2]	13.97	11.77	1.76	8.98	12.92	16.19	5.39	7.35	9.85	9.74

[1] Return on equity is defined as ratio of net income (after taxes) to average shareholders' investment.
[2] Weighted average.

Note: Amount in parentheses indicates minus.

Source: Bureau of Mines, based on analysis of annual reports and form 10-K data submitted to Securities and Exchange Commission.

Table 5.—Fourteen leading U.S. copper producers, return on invested capital, 1969–78[1]

(Percent)

Companies	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Kennecott Copper Corp.	14.74	13.05	7.71	4.85	12.12	14.41	3.23	2.90	2.76	3.54
Phelps Dodge Corp.	15.13	16.82	10.40	10.65	12.30	12.61	6.36	6.01	4.59	5.59
Atlantic Richfield Co.	8.48	5.88	(23.49)	12.40	8.66	19.52	(.50)	3.65	13.21	14.93
Newmont Mining Co.	17.68	16.58	9.54	8.13	16.32	16.10	8.37	7.46	2.95	6.72
Pennzoil Co.	9.82	10.23	6.78	8.76	9.83	11.02	10.15	14.34	10.58	13.27
ASARCO Inc.	15.68	15.24	5.46	7.03	15.11	14.87	4.38	6.19	.55	7.05
Inspiration Consolidated Copper Co.	24.65	28.38	12.51	14.45	12.44	9.12	(1.25)	1.11	(7.09)	(5.02)
Amax Inc.	11.22	8.87	6.12	6.83	9.40	10.53	9.03	8.34	5.61	9.81
Cities Service Co.	4.78	8.41	7.87	7.83	9.27	11.74	8.25	11.78	10.47	6.83
Cyprus Mines Corp.	15.95	16.08	13.50	13.06	15.58	17.24	4.90	4.06	(1.15)	13.57
Louisiana Land and Exploration Co.	14.62	8.76	(2.32)	(3.11)	9.84	14.08	(7.74)	.04	19.47	17.15
Hecla Mining Co.	12.37	11.25	7.93	4.70	6.81	11.35	6.25	(2.21)	8.57	(175.99)
Ranchers Exploration and Development Corp.	10.92	13.19	10.14	8.45	6.09	17.43	14.36	6.63	8.56	18.33
UV Industries Inc.	12.71	4.81	5.24	7.41	10.98	13.55	11.13	13.57	13.48	12.66
All 14 companies[2]	12.05	10.46	3.01	8.19	11.12	13.68	5.97	7.54	9.78	10.22

[1] Return on capital is defined as ratio of net income (after taxes) plus interest cost to average total capital. Total capital is defined as the sum of shareholders' equity and subordinated borrowings.
[2] Weighted average.

Note: Amount in parentheses indicates minus.

Source: Bureau of Mines, based on analysis of annual reports and 10-K data submitted to Securities and Exchange Commission.

Rate of return (R_1)—Average shareholders' equity.

Rate of return (R_2)—Average total invested capital.

$$R_1 = \frac{P}{\frac{E_1 + E_2}{2}} = \frac{2P}{E_1 + E_2} = \text{Return on average shareholder's equity} \quad (1)$$

$$R_2 = \frac{P + I_1}{\frac{V_1 + V_2}{2}} = \frac{2(P + I_1)}{V_1 + V_2} = \text{Return on average total invested capital} \quad (2)$$

Equation 1, often referred to as the financial ratio, measures the earning power of the corporation from the proprietary (equity) point of view. Equation 2, which provides an indication of the economic productivity of capital, is a criterion of the earning power of the corporation (operating efficiency from the standpoint of the suppliers of both borrowed and equity capital).

FINANCIAL ASSESSMENT OF 14 LARGEST U.S. COPPER COMPANIES

The rates of return of the copper companies (tables 4 and 5) indicate a general deterioration in industry profitability since 1969. The exception to this trend is noted for copper concerns that have merged with oil companies and where copper has been replaced as the principal line of business. The actual copper unit results are masked by the performance of the oil segment of the corporate structure.

From 1969 to 1976, just before several large copper producers merged with oil companies, the shareholders' equity of the 14 copper companies increased by less than 50 percent, which indicates the lean profitability and low internal cash flow. Concurrently, the indebtedness of these selected companies increased nearly 130 percent, or more than 2¾ times the increase for shareholders' equity. Several previously debt-free copper companies borrowed heavily during the 1968–79 period. This is partly indicated by the fact that the long-term debt of these firms increased over twice as fast as shareholders' equity. Table 6 lists the ratios of long-term debt to equity for the 14 companies. Although such data must be interpreted carefully because of the different ability of each firm to carry long-term debt, the weaker financial health of the U.S. copper industry was generally reflected in higher long-term debt-equity ratios.

By 1977, the deteriorated financial position of several companies made them attractive acquisition targets. Despite the sagging profits other resource-based companies, especially major oil firms, saw a future potential in financially troubled copper resource companies. Anaconda was acquired by Atlantic Richfield, and Copper Range was bought out by Louisiana Land and Exploration. On the other hand, Kennecott, which was forced to sell its Peabody Coal Co. subsidiary by Federal Government order, di-

Table 6.—Fourteen leading U.S. copper producers, long-term debt-equity ratios, 1969–78

Companies	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Kennecott Copper Corp.	17	15	26	22	16	15	28	38	36	44
Phelps Dodge Corp.	12	13	23	24	34	36	58	62	62	74
Atlantic Richfield Co.	25	30	46	28	24	21	27	30	54	47
Newmont Mining Corp.	11	24	42	45	38	32	38	44	51	47
Pennzoil Co.	137	138	121	137	103	188	178	143	142	117
ASARCO Inc.	3	3	5	7	11	13	40	46	48	36
Inspiration Consolidated Copper Co.	2	1	1	24	56	50	35	30	28	24
Amax Inc.	33	38	56	63	50	41	39	40	41	33
Cities Service Co.	34	31	42	40	38	32	43	37	41	48
Cyprus Mines Corp.	30	21	14	8	6	3	35	67	76	66
Louisiana Land and Exploration Co.	27	22	35	36	31	27	29	27	25	23
Hecla Mining Co.	NA	NA	NA	18	20	32	56	73	100	(107)
Ranchers Exploration and Development Corp.	34	52	21	18	17	14	10	15	12	14
UV Industries Inc.	118	114	169	129	115	95	79	55	90	72

NA Not available.

Note: Amount in parentheses indicates minus.

Source: Company annual reports.

versified by purchasing Carborundum Co., a manufacturer of abrasives.

A brief comparison of tables 4 and 5 shows that the rate of return on shareholders' equity was sometimes above the rate of return on invested capital. This indicates that some of the firms have been able to increase their return on equity through financial leverage, that is, through the use of fixed-interest-rate debt. Interest on such debt is a tax-deductible expense, and capital managers can find that leverage is a good way of raising the return on equity. However, this financial leverage became a disadvantage to some firms when the cost of additional debt increased with the long-term debt-equity ratio. Also, such a practice can be risky. If a substantial downtrend in sales occurs, earnings decline more rapidly, and it may become impossible for a firm to meet its debt service obligations.

Figure 2, which compares the rates of return on shareholders' equity of the 14 U.S. copper mining firms with the average rate of return on shareholders' equity of U.S. manufacturing firms, also depicts deteriorated financial health of the U.S. copper industry. For the 10-year period 1969–78, the 14 U.S. copper mining companies earned an average of 9.8 percent on equity compared to the average 13.4 percent earned by U.S. manufacturing. This is significant because copper mining is riskier than manufacturing. It is subject to geologic uncertainty, long lead times in development that tie up large amounts of capital, the vulnerability of the mining industry to political decisions, and the greater volatility of copper prices (and hence, earnings). These factors normally dictate the copper mining yield a greater rate of return on shareholders' equity than generally less risky manufacturing ventures. For 1979, the rates of return on equity for the U.S. copper companies probably increased significantly because of higher demand and prices for copper and sharply higher prices for byproducts and coproducts such as silver, gold, and molybdenum (*9, 13*).

ENVIRONMENTAL POLICY AND ITS IMPACT

The profitability and financial health of the U.S. copper industry has been significantly affected by public policy actions on environmental quality (*33*). The four steps of copper production—mining, milling, smelting, and refining—are all affected by Federal environmental regulations. Beginning in 1973, domestic copper producers have directed a significant portion of their yearly capital outlays to environmental quality controls such as water and air pollution abatement and land use. These legally mandated capital expenditures, plus the greater uncertainties that are unique to the minerals industry, make the risk of investment much higher than for many other enterprises. Because such elements place considerable constraints on potential investment returns, they discourage investment flows and decrease the copper company's ability to tap the market for capital funds to update and expand plant and equipment.

Table 7 lists capital expenditures of the 14 leading U.S. copper producers for 1969–78. From 1972 to 1976 (just prior to the merger of Anaconda Co. and Copper Range Co. with oil companies), capital spending nearly doubled to about $2 billion. A large part of this increase

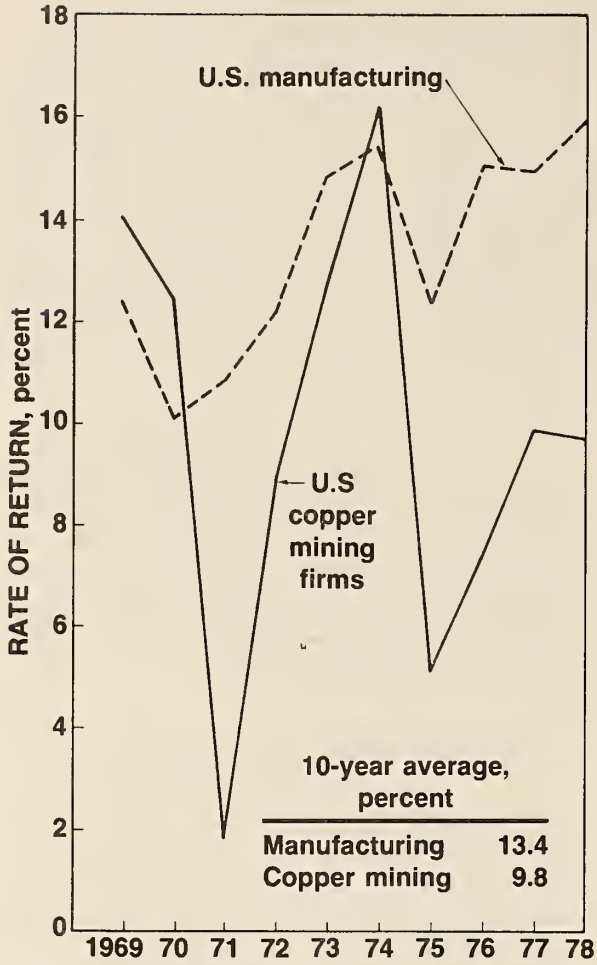

Figure 2. Comparison of estimated rates of return on shareholders' equity, 1969–78.

Sources: First National Bank (New York), Monthly Economic Letter and Bureau of Mines analysis, table 4.

was due to the mandated environmental regulations. During this period, inflation also took its toll through increased prices for capital equipment necessary to assure the continuing efficiency of the mines. Expenditures for pollution control equipment were generally financed through borrowing, thus increasing the long-term debt of companies and raising their debt-equity ratios.

Of all the Federal antipollution regulations, the ones limiting pollutant discharges from copper smelters have had the greatest impact on capital expenditures and thus on production costs. Although the U.S. Environmental Protection Agency (EPA) has issued new proposed rules for nonferrous smelter operations (*35*), the implementation is predicated upon the financial health of the copper companies.

CORPORATE TAXATION AND ITS IMPACT

U.S. copper companies are subject to Federal, State, and local taxes just as are other businesses. These taxes have an effect on the firms' total operations, from current profitability to potential profitability of new investments (*34*).

Federal tax liabilities are generally the largest of all taxes. Although the primary purpose of these taxes is to pay for Federal programs, various revisions to tax laws over the years have been used to solve or ameliorate social, political, and economic problems. For instance, a variety of business deductions and tax credits have been instituted to spur economic activity. There are a number of tax benefits that help the copper industry, including depreciation, depletion allowances, and investment tax credits.

Table 7.—Fourteen leading U.S. copper producers, capital expenditures, 1969–78

(Million dollars)

Companies	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Kennecott Copper Corp.	42.3	48.2	56.3	36.6	63.6	96.1	134.6	136.1	139.2	161.7
Phelps Dodge Corp.	101.8	94.1	90.2	107.2	194.2	296.4	225.6	149.3	117.6	105.9
Atlantic Richfield Co.	127.0	97.0	95.1	126.5	113.5	193.9	128.7	50.0	1,681.3	1,358.2
Newmont Mining Corp.	57.0	135.3	129.1	44.1	47.6	55.8	53.2	53.9	48.2	58.3
Pennzoil Co.	270.0	151.0	89.0	112.0	251.0	237.1	217.4	247.3	264.0	344.0
ASARCO Inc.	25.1	72.2	55.4	66.7	96.7	137.7	167.5	76.0	95.9	79.4
Inspiration Consolidated Copper Co.	9.4	9.7	9.8	27.8	40.8	18.8	2.8	2.1	3.3	8.2
Amax Inc.	139.0	169.0	130.0	148.0	256.0	408.0	550.0	532.0	409.0	403.0
Cities Service Co.	242.8	285.1	296.5	261.7	402.2	446.8	439.4	524.3	501.1	637.2
Cyprus Mines Corp.	89.5	35.0	43.3	28.5	43.3	74.9	107.2	153.6	124.7	49.1
Louisiana Land and Exploration Co.	12.1	14.0	11.9	4.1	5.5	7.5	10.5	3.1	147.3	191.7
Hecla Mining Co.	4.5	7.9	11.8	17.9	1.7	28.5	28.3	8.5	1.6	1.2
Ranchers Exploration and Development Corp.	1.8	10.7	5.1	.9	1.9	1.6	1.0	3.3	1.4	9.2
UV Industries Inc.	8.9	7.9	15.2	20.4	22.7	22.6	21.9	19.6	23.9	23.6
Total 14 companies	1,131.2	1,137.1	1,038.7	1,002.4	1,540.7	2,025.8	2,088.1	1,959.1	3,588.2	3,430.7

Source: Bureau of Mines, based on analysis of annual reports and form 10-K data submitted to Securities and Exchange Commission.

Table 8.—Fourteen leading U.S. copper producers, effective income tax rates, 1969–78

(Percent)

Companies	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Kennecott Copper Corp.	28.1	24.2	4.2	12.8	25.0	27.2	(74.5)	(74.7)	(136.7)	62.7
Phelps Dodge Corp.	32.8	37.2	33.8	33.1	37.3	26.5	(29.8)	9.1	21.5	16.9
Atlantic Richfield Co.	46.3	10.6	[1]	11.1	24.3	33.8	[1]	28.0	27.6	42.5
Newmont Mining Corp.	33.2	31.5	19.8	26.6	27.9	28.5	29.6	30.7	(186.2)	34.2
Pennzoil Co.	[1]	6.1	2.2	17.3	13.8	21.7	25.4	30.0	32.0	33.5
ASARCO Inc.	21.4	22.2	10.0	16.2	16.9	21.4	(65.6)	21.9	22.6	31.1
Inspiration Consolidated Copper Co.	29.7	33.2	27.8	27.4	4.2	14.3	(23.5)	(168.1)	(8.9)	[1]
Amax Inc.	13.5	25.1	18.8	23.6	26.5	27.1	15.8	4.2	3.9	21.1
Cities Service Co.	25.5	27.8	14.3	17.9	28.9	30.4	41.9	43.9	44.9	42.8
Cyprus Mines Corp.	36.9	34.7	30.7	21.6	30.2	35.9	23.9	(4.7)	(148.6)	19.6
Louisiana Land and Exploration Co.	18.9	29.4	(42.4)	(40.8)	37.2	28.0	(36.0)	(47.9)	44.4	44.6
Hecla Mining Co.	31.5[e]	31.6[e]	30.6[e]	18.0	27.0	33.0	37.0	(47.0)	(20.0)	(5.0)
Ranchers Exploration and Development Corp.	5.4	29.8	15.5	7.1	23.1	25.6	32.0	41.7	34.9	30.9
UV Industries Inc.	40.9	15.6	45.5	46.3	44.5	47.0	45.0	42.0	46.4	43.1

[e] Estimated.
[1] Loss for the period or tax loss carry forward position.

Note: Amount in parentheses indicates minus (loss).

Source: Bureau of Mines, based on analysis of annual reports and form 10-K data submitted to Securities and Exchange Commission.

The 14 U.S. copper companies have utilized tax benefits in different ways so that they have different effective income tax rates. Table 8 lists these effective tax rates, which were affected by the following:

a. Percentage depletion in excess of cost depletion;
b. Foreign and other income subject to lower tax rates;
c. Investment tax credits;
d. State and local income tax;
e. Tax on undistributed earnings;
f. Excess of intangible development costs deducted;
g. Tax loss carry forward benefits;
h. Minimum tax; and
i. Others.

These effective tax rates are the ones that the copper companies use for operational planning, for investment decisions, and for determining whether to finance investments through debt or equity. On the other hand, tax benefits are discounted by credit institutions and investment analysts when judging management's capability, the firm's credit rating, its ability to attract capital, and the cost of capital.

Tax policies can be an incentive or a disincentive to investment. The inflationary economy of the past 10 to 15 years has resulted in inflated profits, primarily because depreciation of plant and equipment is based on historical costs and not inflated replacement costs. This overstates profits, and thus higher effective taxes are being paid. As a result, cash flows in real terms are lower than they would have been in a noninflationary economy, and new investments and exploration, research, and development are hurt. One modification to the tax structure currently being prepared in Congress would help all business, including copper companies, by allowing faster depreciation of plant and equipment. If passed into law this would decrease effective tax rates and thus increase the profitability of potential investments.

DYNAMICS OF CORPORATE STRUCTURE AND BEHAVIOR

Like most U.S. enterprises, copper producers generally started as small companies, many as groups of miners. In the early periods, the industry was extremely labor intensive. As demand for copper increased, competition within the industry developed and prompted the application of more efficient and economical methods of mining to reduce costs and thus increase profits. The exhaustion of more accessible and richer deposits necessitated mining of ore lower in copper content and lying at greater depth. This stimulated technological advancement not only in mining methods but also in increased use of power equipment, in improvements of drilling, loading, and hauling equipment, and in metallurgical technology. This required huge capital expenditures, which small producers could not afford. Because nearly all improvements in mining methods and technological advancements led to greater economies of scale, the U.S. copper industry is mainly composed of large, integrated producers that in some cases are part of multiproduct, multinational organizations and joint ventures. The 1969–78 period witnessed further alterations of corporate structure and behavior—notably in the areas of diversification, interconnections among firms, copper investment strategy, and financing techniques.

DIVERSIFICATION AND MERGER

During the 1960's, radical changes were being initiated in the corporate structure and behavior of business (7). It was common practice for companies to become involved in conglomerates via mergers or other methods of diversification. The copper industry was no exception to this trend. During the 1960's, two significant copper producers were involved in mergers. Cities Service Co. acquired the Tennessee Corp. in June 1963 and Pennzoil Co. acquired control of Duval Corp. in August 1968. The main purpose of these mergers was probably to diversify revenue sources (see table 9), making copper a smaller source of total revenues. During this period, the copper companies were generally healthy with few debts and acceptable credit ratings, despite major expropriation losses on foreign investments during the latter 1960's and early 1970's.

Beginning in the mid-1970's, the copper industry encountered difficult times because of mandated expenses for environmental, safety, and health regulations (air pollution, water pollution, and solid wastes); steadily rising fuel costs; excess capacity; and lower copper prices. All of the above factors contributed to sagging profits or losses. It was necessary for previously debt-free copper companies to incur debt to finance the costs of required environmental controls. This in turn created a much higher debt-equity ratio, which forced credit-rating institutions to downgrade the ratings for indebtedness. These lower credit ratings made it difficult to borrow further needed funds.

Table 9.—Fourteen leading U.S. copper producers, shift in corporate business composition, 1969–78

(Percent of copper and copper product sales to total revenues)

Companies	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Kennecott Copper Corp.	77.9	78.3	80.3	77.1	78.0	74.5	63.1	72.5	65.7	38.5
Phelps Dodge Corp.	NA	NA	NA	NA	NA	NA	NA	98.6	96.7	96.0
Atlantic Richfield Co.[1]	80.6	74.4	70.0	69.3	71.5	69.5	57.5	51.5	6.4	5.3
Newmont Mining Corp.	73.2	67.4	64.1	71.3	69.2	59.8	42.7	47.8	43.2	43.8
Pennzoil Co.	22.3	24.9	33.0	32.5	28.7	23.6	20.0	18.7	20.7	22.0
ASARCO Inc.	36.6	35.9	32.2	32.4	30.4	21.6	16.7	24.1	20.5	26.4
Inspiration Consolidated Copper Co.	86.7	87.2	85.9	86.4	85.2	84.5	70.0	68.8	63.4	56.0
Amax Inc.[2]	NA	21.0	15.0	19.0	17.0	17.0	11.0	15.0	14.0	16.0
Cities Service Co.	6.1	6.1	5.5	5.9	6.6	4.8	4.4	5.5	4.1	5.1
Cyprus Mines Corp.	33.2	37.4	35.3	35.7	34.8	30.6	27.5	27.8	25.9	29.2
Louisiana Land and Exploration Co.	99.0	98.4	98.6	97.7	98.1	98.3	97.4	96.5	17.7	20.1
Hecla Mining Co.	5.8	7.3	7.2	6.2	1.0	1.0	.9	38.5	45.4	6.6
Ranchers Exploration and Development Corp.	84.2	92.4	89.4	81.4	91.5	93.4	83.1	74.1	56.1	25.3
UV Industries Inc.	NA	NA	40.0	41.0	42.0	47.0	33.0	37.0	38.0	36.0

NA Not available.

[1] Anaconda Co. acquired Jan. 12, 1977. All data prior to Jan. 12, 1977, cover Anaconda Co. only.

[2] Anamax Mining Co. was formed June 1973 through equal partnership with Anaconda Co., a unit of Atlantic Richfield Co.

[3] Copper Range Co. acquired May 24, 1977. All data prior to this date cover Copper Range Co. only.

Source: Bureau of Mines, based on analysis of annual reports and form 10-K data submitted to Securities and Exchange Commission.

The weakened financial position of some copper firms led to several acquisitions in the post-1976 period by oil companies. Anaconda was acquired by Atlantic Richfield in January 1977, and Copper Range was merged into Louisiana Land and Exploration Co. in May 1977. Furthermore, Standard Oil of Indiana acquired Cyprus Mines in April 1979. Apparently, some oil firms saw potential long-term value despite the financial trouble of the copper companies, and viewed copper mining as a logical extension of their present resource extraction business. Also, the purchase prices of several of the acquired firms—Anaconda and Copper Range—were roughly half of the book values of the firm.

Other oil companies also apparently believe that the minerals industry—and copper in particular—offers a good potential for profit (tables 10 and 11). One firm, Inspiration Consolidated Copper Co., is controlled by two related Canadian firms—Hudson Bay Mining and Smelting Co., Ltd., and Minerals and Resources Corp., Ltd.—which have substantial oil and gas interests. Standard Oil of California owns a 20.6-percent interest in Amax, the diversified minerals producer, and unsuccessfully attempted to take Amax over. On the other hand, Exxon has chosen to start up its own copper company; it has purchased a mine in Chile and has been evaluating a plan for opening a copper mine in Wisconsin. Still others—Getty Oil Co. and Occidental Petroleum Corp.—own undeveloped copper properties in Arizona.

Other nonoil companies have also shown an interest in nonrenewable resources, including copper. General Electric Co., through its Utah International subsidiary, has taken a position in Australian copper mining. Bendix Corp., a diversified manufacturer, has purchased a 20-percent interest in ASARCO, one of the 14 major U.S. copper producing firms.

Of the remaining copper majors, Kennecott and Phelps Dodge have chosen to diversify in different ways. Kennecott, which attempted an earlier diversification through its purchase of Peabody Coal, was forced to sell off this segment of its business for antitrust reasons. With the resulting spare cash, it then purchased Carborundum Co.—a manufacturer of abrasives—in order to reduce the firm's sensitivity to swings in the price of copper. Since the late 1977 acquisition, the portion of copper sales to total revenues fell to roughly 40 percent from about 66 percent. Phelps Dodge, although it has entered the uranium and aluminum business, still derived 96 percent of its sales from copper in 1978.

INTERCONNECTIONS AMONG COPPER FIRMS

Another change that has apparently taken place in the U.S. copper industry is the move

Table 10.—Industry affiliation of selected copper producing groups in 1978

Copper-producing groups subsidiary or division	Controlling company	1978 copper production, 1,000 short tons	Percent of industry total	Industry affiliation, percent of total industry 1978 production		
				Copper	Petroleum	Other minerals
Kennecott copper divisions	Kennecott Copper Corp.	318.2	21.3	21.3		
Phelps Dodge mines	Phelps Dodge Corp.	319.0	21.4	21.4		
Anaconda Co.	Atlantic Richfield Co.	142.8	9.6		9.6	
Magma Copper Co. and divisions	Newmont Mining Corp.	156.9	10.5	10.5		
Duval and Duval Sierrita Corps.	Pennzoil Co.	118.0	7.9		7.9	
ASARCO Mines	ASARCO Inc.	100.9	6.8			6.8
Inspiration Consolidated Copper Co.	Hudson Bay Mining & Smelting Co. Ltd. (Canada) Minerals & Resources Corp. Ltd. (Bermuda)	39.7	2.7		2.7	
Anamax Mining Co. (50%)	Amax Inc.	52.1	3.5			3.5
Copperhill and Miami operations	Cities Service Co.	90.8	6.1		6.1	
Group of copper companies	Cyprus Mines Corp.[1]	70.7	4.7		4.7	
Copper Range Co.	Louisiana Land and Exploration Co.	40.7	2.7		2.7	
Lakeshore Mine (50%) and others	Hecla Mining Co.	.6	Insig.			Insig.
Group of copper mines	Ranchers Exploration and Development Corp.	8.2	.6			.6
Continental mine	UV Industries Inc.	5.4	.4		.4	
Total 14 companies' copper production in U.S.		1,464.0	98.2	53.2	33.7	11.3
Total U.S. copper production		p1,490.3				

p Preliminary.
[1] Became a wholly owned subsidiary of Standard Oil Co. of Indiana on Sept. 21, 1979.

Source: Bureau of Mines, based on analysis of annual reports and form 10-K data submitted to Securities and Exchange Commission.

Table 11.—Petroleum companies' connections with the copper industry—domestic and foreign as of yearend 1979

Oil and gas companies	Interest in U.S. copper producers or copper resources (location)[1]	Interest in foreign copper producers or resources
Atlantic Richfield Oil Co.	Anaconda Company (100)	None.
British Petroleum Co., Ltd.	None	Western Mining Corp. Ltd.
Cities Services Co.	Tennessee Copper Co. (100)	None.
Continental Oil Co.	Florence, Ariz.	None.
Exxon Corp.	Grandon, Wis.	Compania Minera Disputada des Las Condes SA.
Getty Oil Co.	Casa Grande, Ariz.	None.
Hudson Bay Mining and Smelting Co., Ltd.; Minerals and Resources Corp., Ltd.	Inspiration Consolidated Copper Co. (73)	Whitehorse Copper Mines Ltd.
Louisiana Land & Exploration Co.	Copper Range Co. (100)	None.
Occidental Petroleum Corp.	Miami, Ariz.	None.
Pennzoil Co.	Duval Corp. (100)	None.
Royal Dutch Petroleum Co.	None	Billiton United Kingdom.
Standard Oil Co. (California)	Amax Corp. (20.6)	None.
Standard Oil Co. Indiana	Cyprus Mines Corp. (100)	None.
Superior Oil Co.	None	McIntyre Mines Ltd.
Union Oil Co.	Cyprus Pima Mining Co. (24.9)	None.

[1] Amounts in parentheses ( ) indicate percent of interest.

Source: Bureau of Mines, based on analysis of annual reports and form 10-K data submitted to Securities and Exchange Commission.

towards direct and indirect connections among producers. The major vehicle for direct connections among producers is the joint venture. Generally, firms enter into joint ventures in order to spread the risks involved in any given investment project. Within the United States, one example of a joint venture is Anamax Mining Co., formed in June 1973 as a joint venture of Amax, the Anaconda unit of Atlantic Richfield, Standard Oil of California, and Selection Trust, Ltd. (UK). One prime example of a joint overseas venture is the Southern Peru Copper Corp. which is jointly owned by ASARCO, the Marmon Group, Newmont Mining Corp., and Phelps Dodge Overseas Capital Corp. Such joint ventures enable firms to participate in the profits from lower cost overseas operations while limiting losses in case of any future expropriation action by a host country.

Indirect connections among U.S. copper companies—which may be described as extremely indirect—occur because of the representation of financial institutions on the board of directors (see table 12). These directors from financial institutions—many of whom are affiliated with the banking industry—provide expertise in setting company financial policies and provide access to financial markets to meet short- to-long-range capital requirements. Virtually all of the so-called Big Six copper companies have at least one representative of a major financial institutional on their boards of directors. The indirect connections between companies can occur because a number of banks are often involved in major loans to a single firm. Often, one or more of these banks or financial institutions might be involved in loans to several firms in the same industry. As a result, information on the financial health and plans of competing firms can become broadly disseminated to those financial officers serving on the boards of these competitors. This potential for information transfer can occur in the U.S. copper industry and could possibly have an influence on investment decisions.

COPPER INVESTMENT STRATEGY—DOMESTIC VERSUS FOREIGN

The general financial weakness of the U.S. copper industry during the 1969–78 period has apparently led these firms to strike a new balance between domestic and foreign investment in copper projects. As stated in the section on

Table 12.—Composition of boards of directors of copper producers, 1978

Companies	Total Board members	Board members connected to financial institutions
Kennecott Copper Corp.	18	4
Phelps Dodge Corp.	18	4
Atlantic Richfield Co.	17	2
Newmont Mining Corp.	13	1
Pennzoil Co.	14	1
ASARCO Inc.	14	2
Inspiration Consolidated Copper Co.	10	1
Amax Inc.	18	5
Cities Service Co.	14	3
Cyprus Mines Corp.	15	2
Louisiana Land and Exploration Co.	10	2
Hecla Mining Co.	6	0
Ranchers Exploration and Development Corp.	7	1
UV Industries Inc.	15	0

Source: Bureau of Mines, based on analysis of annual reports and form 10-K data submitted to Securities and Exchange Commission.

the overview of the copper industry, U.S. copper companies have not yet announced plans to expand net capacity despite the Bureau of Mines' forecast for needed extra domestic mine and refined output by the year 2000. Apparently, the costs of meeting environmental standards, the specter of futher increases in energy, labor, and capital costs, and the lack of high-grade ore have generally led U.S. copper companies to forestall domestic capacity expansion plans. Instead most companies appear to be limiting domestic investment to mandated antipollution expenditures and to investments that cut costs of present mining and refining operations. Also, some of the companies are still intent on improving their balance sheets by reducing indebtedness.

On the other hand, some U.S. firms are channeling money into overseas copper ventures (see fig. 3), which appear more profitable than domestic ones. As mentioned previously, some of the overseas ventures are—

- Compania Minera Disputada des Las Condes, S.A., an Exxon subsidiary in Chile.
- Southern Peru Copper Corp. in Peru, a joint venture of ASARCO, Inc. the Marmon Group, Newmont Mining Corp., and Phelps Dodge Overseas Capital Corp.
- Utah International, General Electric subsidiary, in an Australian venture.
- Newmont Mining Corp., through various subsidiaries, in Canada and the Republic of South Africa.

Apparently, the higher grade (and hence lower cost) deposits overseas are profitable enough to offset any potential risks of overseas operations.

Figure 3. Leading U.S. copper producers, foreign investment flows.

Source: Bureau of Mines, based on analysis of annual reports and form 10-K data submitted to Securities and Exchange Commission.

NEW FINANCING METHODS

U.S. copper companies are also taking advantage of new methods of financing business compared to that of earlier years. Since copper profits have been low, and straight debts (debentures) have increased, raising the debt-equity ratio, several companies have instituted equity financing through divided reinvestment plans to lower the debt-equity ratio. This financing plan permits quarterly investments by shareholders; in addition to dividends, an amount usually from $25 up to a maximum of $3,000 can be invested. Although participation is strictly voluntary, some shareholders take advantage of this free service because they can avoid paying broker's commissions. Furthermore, U.S. copper producers with multinational operations have access to international money markets to finance copper projects in foreign countries. The issuance of debt instruments, such as Eurobonds, may be an advantage when interest rates and foreign exchange rates are considered.

In some cases, domestic copper producers may receive assistance from the respective State and local governments by financing antipollu-

tion facilities with tax-exempt revenue bonds. Though these bonds are issued by the governments, the repayment and costs of funds are guaranteed by the respective copper company. The tax-exempt status of the bonds reduces interest payments and thus cuts the cost of pollution control facilities.

Another finacing vehicle used to raise immediate working capital is to obtain a commitment of several financial institutions for letters of credit that are needed to support the company's issuance of commercial paper. Commercial paper, which is virtually a corporate signature loan, can be used as a way of obtaining short-term funds at interest rates that are often less than those charged by banks.

Project financing is a way of raising funds that has facilitated joint ventures for new mines. It came into wide use when capital costs increased sharply and leading institutions began to require greater amounts of equity interest as a condition for lending. This system of financing can be a little more expensive than borrowing on the strength of the primary companies' financial-economic position, but the loan need not be reflected on their financial statements. Thus, a project loan need not affect a firm's credit standing. This type of financing also reduces the total capital contribution of any one company.

Similar financing instituted on an international basis may involve several companies with one in each of three basic categories, "investor-host-market." In this instance, "investor" (supplier) represents the financing and technological capability (generally U.S.); the "host" represents the mineral resource country; and the "market" represents the consuming country or firm. A sales contract for the project's output is commonly required before full financing can be arranged (*26–28*). The contract serves the purpose of guaranteeing a market for raw material (concentrate and blister copper). The supplier's credits (investor) are loans or loan guarantees by agencies such as the U.S. Export-Import Bank (*25*) for the purchase of supplies and equipment by the foreign producing firm from U.S. equipment manufacturers. The consuming country (the U.S. copper company) may also be a source of long-term funds—it may lend capital against long-term supply contracts.

SUMMARY OF TRENDS IN THE U.S. COPPER INDUSTRY AND CONCLUSIONS

In addition to facing geologic uncertainty, over the 1969–78 period the U.S. copper industry has faced higher production costs, lower ore grades, mandated investments in pollution control equipment, and greater competition from lower cost foreign producers. Together, these and other factors led to a deterioration in the financial health of the U.S. copper industry as measured by lower rates of return on shareholders' equity and, in some cases, an inability to raise needed funds from capital markets.

Several changes have taken place that should improve the financial health of the U.S. copper industry. These dynamic changes included:

- Diversification and merger. Some oil companies acquired copper companies, and others established their own copper subsidiaries, while the remaining copper companies have diversified their product base.
- The use of joint ventures to spread the risks of copper mining projects, particularly in overseas operations, and the increased reliance on the financial community—with its internal connections—for advice on financing and access to capital markets.
- The shift in investment strategy toward the expansion of capacity in low-cost foreign producing countries, while generally limiting U.S. investment to mandated environmental expenses and equipment that increase the productivity of present operations.
- The use of new financing methods, particularly project financing, as a way of limiting a firm's investment in foreign ventures.

These measures are likely to raise the rate of return on shareholders' equity and improve the financial health of the U.S. copper industry over the medium term. Domestic capacity expansion, which the Bureau of Mines estimates will be needed during the next 20 years, is apparently being held back until the long-term real copper price rises enough to make such domestic ventures more profitable. Without the improved financial health that will result from these actions, the U.S. copper companies would not have the financial resources to expand domestic operations when future market conditions are favorable.

The Nation's future copper supply decisions and policymaking processes will involve four dynamic organizations: First, the Federal Government, to cover the Nation's social and economic policies, placing different priorities in the area of foreign exchange, revenues, and employment levels; second, the private banks and other lending institutions, to safeguard their loans to copper producers and to state-owned copper companies of foreign governments; third, the independent U.S. copper firms, interested in the economics of copper mining, that is, an adequate rate of return on capital employed commensurate with the degree of risk; fourth, the oil companies with copper interests, the new participants with excellent financial position and with top credit ratings. The oil companies' immediate contributions should be to lower the financing cost of capital for expansion and improvement of mines, possibly in the range of 100 to 200 basis points. The interactions of these four institutions in the Nation's copper decisionmaking process should lead to a policy for a healthy and competitive U.S. copper industry.

In aggregate, the U.S. copper industry is financially stronger than a few years ago. Already, several copper corporations have made huge investments overseas in copper, individually and through joint ventures to diversify geographically their copper production.

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